WHAT IS CLAIMED IS:

1 A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising a rumble strip sensor adapted to sense input from a rumble strip, wherein the sensor includes:

a vibration sensor in communication with at least one of a sprung mass and an unsprung mass, the vibration sensor being adapted to determine a frequency of vibration of the sprung mass or the unsprung mass and to output a signal indicative of the frequency of vibration of the sprung mass or the unsprung mass; and

a processor in communication with the vibration sensor and adapted to receive the signal, wherein the processor is also adapted to analyze the signal and determine whether the frequency of vibration is indicative of tire contact with a rumble strip based on the signal.

2. The device of claim 1, wherein the vibration sensor is a gravity sensor.

3. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising a rumble strip sensor adapted to sense input from a rumble strip, wherein the sensor includes:

a shock absorber assembly adapted to output a signal indicative of the state of a dampening portion of the shock absorber; and

a processor in communication with the shock absorber assembly and adapted to receive the signal, wherein the processor is also adapted to analyze the signal and determine whether the shock absorber is absorbing shock indicative of tire contact with a rumble strip based on the signal.

4. The device of claim 3, wherein the shock absorber assembly is adapted to output a signal indicative of at least one of a pressure, a change in pressure, and a rate of change in pressure in a dampening portion of the shock absorber, and wherein the processor is also adapted to analyze the signal and determine whether the pressure, change in pressure, and the rate of change in pressure in the dampening portion of the

shock absorber is indicative of tire contact with a rumble strip based on the signal.

5. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising a rumble strip sensor adapted to sense input from a rumble strip, wherein the sensor includes:

a wheel assembly adapted to output a signal indicative of the state of compression in a tire portion of the wheel assembly; and

a processor in communication with the wheel assembly and adapted to receive the signal, wherein the processor is also adapted to analyze the signal and determine whether the state of compression is indicative of tire contact with a rumble strip based on the signal.

6. The device of claim 5, wherein the wheel assembly is adapted to output a signal indicative of at least one of a pressure, a change in pressure, and a rate of change in pressure in the tire, and wherein the processor is also adapted to analyze the signal and determine whether the pressure, change in pressure, and the rate of change in pressure is indicative of tire contact with a rumble strip.

7. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising a rumble strip sensor adapted to sense input from a rumble strip, wherein the sensor includes:

a wheel assembly adapted to output a signal indicative of a state of rotation of at least a portion of the wheel assembly; and

a processor in communication with the wheel assembly and adapted to receive the signal, wherein the processor is also adapted to analyze the signal and determine whether the state of rotation of the portion of the wheel assembly is indicative of tire contact with a rumble strip based on the signal.

8. The device of claim 7, wherein the wheel assembly is adapted to output a signal indicative of at least one of a rotation speed, a change in rotation speed, and a rate of change in rotation speed of the portion of the wheel assembly, and wherein the

processor is also adapted to analyze the signal and determine whether the rotation speed, the change in rotation speed, and the rate of change in rotation speed of the portion of the wheel assembly is indicative of tire contact with the rumble strip based on the signal.

9. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising a rumble strip sensor adapted to sense input from a rumble strip, wherein the sensor includes:

a microphone adapted to output a signal indicative of sound sensed by the microphone; and

a processor in communication with the microphone and adapted to receive the signal, wherein the processor is also adapted to analyze the signal and determine whether sound sensed by the microphone is indicative of tire contact with a rumble strip based on the signal.

10. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising a rumble strip sensor adapted to sense input from a rumble strip, wherein the sensor includes:

a displacement sensor including a sprung mass, the displacement sensor being adapted to determine a state of displacement of the sprung mass which is displaced by input from a rumble strip and output a signal indicative of the state of displacement; and

a processor in communication with the displacement sensor and adapted to receive the signal, wherein the processor is also adapted to analyze the signal and determine whether the state of displacement of the sprung mass is indicative of tire contact with a rumble strip based on the signal.

11. The device of claim 10, wherein the displacement sensor comprises at least one of a distance sensor, a suspension stroke sensor, and an ultra-sonic sensor.

12. The device of claim 10, wherein the displacement sensor is adapted to output a

signal indicative of at least one of a displacement speed, a change in displacement speed, and a rate of change in displacement speed of the sprung mass, and wherein the processor is also adapted to analyze the signal and determine whether the displacement speed, the change in displacement speed, and the rate of change in displacement speed of the sprung mass is indicative of tire contact with a rumble strip based on the signal.

13. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising a rumble strip sensor adapted to detect the presence of a rumble strip, wherein the sensor includes:

a displacement sensor adapted to determine a state of displacement of a road surface relative to a location on the vehicle as the vehicle moves along the road and to output a signal indicative of the state of displacement; and

a processor in communication with the displacement sensor and adapted to receive the signal, wherein the processor is also adapted to analyze the signal and determine whether the state of displacement of the road surface is indicative of the presence of a rumble strip based on the signal.

14. The device of claim 13, wherein the displacement sensor is adapted to output a signal indicative of at least one of a displacement speed, a change in displacement speed, and a rate of change in displacement speed of the road surface relative to the location on the vehicle, and wherein the processor is also adapted to analyze the signal and determine whether the displacement speed, the change in displacement speed, and the rate of change in displacement speed of the road surface relative to the location on the vehicle is indicative of the presence of a rumble strip based on the signal.

15. A device adapted to estimate lateral displacement of a vehicle based on the location of a road departure warning installation installed on a road with respect to the vehicle, comprising:

a processor adapted to receive four signals indicative of contact of a rumble

strip with respective associated four tires of the vehicle, wherein the processor is further adapted to estimate a lateral distance that the vehicle has traveled beyond the detected rumble strip based on which of the four tires is associated with a respective signal.

16. The device according to claim 15, wherein the processor contains information on a vehicle geometry relating to the distance between at least one location on the vehicle and at least one of the four tires, and wherein the processor is adapted to utilize the information to estimate the lateral distance that the vehicle has traveled beyond the detected rumble strip.

17. The device according to claim 15, wherein the processor is further adapted to estimate the lateral distance that the vehicle has traveled beyond the detected rumble strip based on the order in which the signals are received by the processor.

18. The device according to claim 15, wherein the processor is further adapted to estimate the lateral distance that the vehicle has traveled beyond the detected rumble strip based on the time between a first signal reception by the processor indicative of contact of a rumble strip with an associated first tire and a second signal reception by the processor indicative of contact of a rumble strip with an associated second tire.

19. The device according to claim 18, wherein the processor is further adapted to estimate the lateral distance that the vehicle has traveled beyond the detected rumble strip based on the longitudinal speed of the vehicle.

20. A device adapted to estimate lateral displacement of a vehicle based on the location of a road departure warning installation installed on a road with respect to the vehicle, comprising:

a processor adapted to receive four signals indicative of contact of a rumble strip with respective associated four tires of the vehicle, wherein the processor is further adapted to estimate a direction in which the vehicle is traveling with respect to

the direction of a plurality of detected rumble strips based on information contained in the processor regarding a vehicle geometry relating to the distance between at least one location on the vehicle and at least one of the four tires.

21. The device according to claim 20, wherein the processor is further adapted to estimate the direction in which the vehicle is traveling with respect to the direction of the plurality of detected rumble strips based on the time between a first signal reception by the processor indicative of contact of a rumble strip with an associated first tire and a second signal reception by the processor indicative of contact of a rumble strip with an associated second tire.

22. The device according to claim 20, wherein the processor is further adapted to estimate the direction in which the vehicle is traveling with respect to the direction of the plurality of detected rumble strips based on the longitudinal speed of the vehicle.

23. A device adapted to estimate lateral displacement velocity of a vehicle based on the location of a road departure warning installation installed on a road with respect to the vehicle, comprising:

a processor adapted to receive at least a first signal and a second signal indicative of contact of a rumble strip with respective associated two tires of the vehicle, wherein the processor is further adapted to estimate a lateral speed at which the vehicle is traveling away from a detected rumble strip based on:

a time period between when the first signal is received by the processor and when the second signal is received by the processor; and

a tread distance between the two tires.

24. The device according to claim 23, wherein the estimation of lateral speed (Dv) is determined based on the equation:

$$\mathbf{Dv = Td/\Delta t}$$

where,

Td = tread distance, and

Δt = time between receiving the first signal and receiving the second signal.

25. A device adapted to estimate the heading of a vehicle based on the location of a road departure warning installation installed on a road with respect to the vehicle, comprising:

a processor adapted to receive at least a first signal and a second signal indicative of contact of a rumble strip with respective associated two tires of the vehicle, wherein the processor is further adapted to estimate an angle at which the vehicle is traveling away from a plurality of detected rumble strips based on:

a time period between when the first signal is received by the processor and when the second signal is received by the processor;

a longitudinal vehicle speed; and

a tread distance between the two tires.

26. The device according to claim 25, wherein the estimation of the angle (θ) at which the vehicle is traveling away from the plurality of detected rumble strips (Dv) is determined based on the equation:

$$\tan\theta = Td / (v \cdot \Delta t)$$

where,

Td = tread distance,

v = longitudinal speed of the vehicle, and

Δt = time between receiving the first signal and receiving the second signal.

27. A device adapted to determine whether a vehicle is deviating into an oncoming lane of an un-divided highway, comprising:

a processor adapted to receive at least a first signal indicative of contact of a rumble strip with a tire of the vehicle, wherein the processor is further adapted to

receive a second signal indicative of a RADAR return of an oncoming vehicle, the processor including logic to:

determine that the vehicle is deviating into an oncoming lane when the processor has received the first signal and the second signal.

28. The device according to claim 27, wherein the logic determines that the vehicle is deviating into an oncoming lane when the first signal and the second signal are received by the processor at the same time.

29. The device according to claim 27, wherein the processor is adapted to determine the time period between receipt of the first signal and the second signal, and wherein the logic determines that the vehicle is deviating into an oncoming lane based on the time period between receipt of the first signal and receipt of the second signal.

30. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle, comprising:

a road sensor adapted to sense vibrational input from a road surface into a tire of a vehicle and output a signal indicative of the level of input from the road surface into the tire; and

a processor adapted to receive the signal from the sensor and determine whether the input from the road surface into the tire is indicative of input from an asphalt road or a concrete road, wherein the processor includes logic to determine whether the input from the road surface is also indicative of input from a rumble strip, the logic being based on:

a first level of input from the road surface during a first time period; and

a second level of input from the road surface during a second time period after the first time period; wherein

the processor determines the difference between the second level of input and the first level of input; and

the processor determines that the input from the road surface is indicative of input from a rumble strip if the difference is greater than a variable predetermined difference, the variable predetermined difference being greater when the vehicle is driving on an asphalt road than when the vehicle is driving on a concrete road.

31. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising:

a road sensor adapted to sense vibrational input from a road surface into a tire of a vehicle and output a signal containing data indicative of the level of input from the road surface into the tire; and

a processor adapted to receive the signal from the sensor and determine whether the input from the road surface into the tire is indicative of input from an asphalt road or a concrete road by comparing the data in the signal to data stored indicative of the level of input from an asphalt road surface into the tire sensed by the road sensor and data stored indicative of the level of input from a concrete road surface into the tire; wherein

the processor is further adapted to determine whether the signal containing data indicative of the level of input from a road surface into the tire contains data indicative of input from a rumble strip into the tire based on:

the difference between the stored level of input into the tire sensed by the road sensor and at least one of the stored level of input for an asphalt road and the stored level of input for a concrete road; wherein

the processor determines that the signal contains data indicative of input from a rumble strip into the tire if the difference is greater than a predetermined difference, the predetermined difference being greater for asphalt roads than for concrete roads.

32. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising:

a road sensor adapted to sense vibrational input from a road surface into a tire of a vehicle and output a signal indicative of peak vibrational input from the road surface into the tire; and

a processor adapted to receive the signal from the sensor and determine whether the peak input from the road surface into the tire is indicative of input from an asphalt road or a concrete road, wherein the processor includes logic to determine whether the input from the road surface is also indicative of input from a rumble strip, the logic being based on:

a first level of input from the road surface during a first time period; and

a second level of input from the road surface during a second time period after the first time period; wherein

the processor determines the difference between the second level of input and the first level of input; and

the processor determines that the input from the road surface is indicative of input from a rumble strip if the difference is greater than a variable predetermined difference, the variable predetermined difference being greater when the vehicle is driving on an asphalt road than when the vehicle is driving on a concrete road.

33. The device according to claim 32, wherein the device includes a band-pass filter adapted to filter out vibrational frequencies.

34. The device according to claim 32, wherein the band-pass filter is a variable band-pass filter adapted to filter out different frequencies based on vehicle velocity.

35. The device according to claim 32, wherein the processor is adapted to receive information relating to longitudinal velocity of the vehicle and output a signal indicative of peak vibrational output from the road surface into the tire based on the longitudinal velocity.

36. A device adapted to detect a road departure warning installation installed on a road that comes into contact with a tire of a vehicle comprising:

a road sensor adapted to sense vibrational input from a road surface into a tire of a vehicle and output a signal containing data indicative of the peak vibrational

input from the road surface into the tire; and

a processor adapted to receive the signal from the sensor and determine whether the input from the road surface into the tire is indicative of input from an asphalt road or a concrete road by comparing the data in the signal to data stored indicative of the level of input from an asphalt road surface into the tire sensed by the road sensor and data stored indicative of the level of input from a concrete road surface into the tire; wherein

the processor is further adapted to determine whether the signal containing data indicative of the level of input from a road surface into the tire contains data indicative of input from a rumble strip into the tire based on:

the difference between the level of input into the tire sensed by the road sensor and at least one of the stored level of input for an asphalt road and the stored level of input for a concrete road; wherein

the processor determines that the signal contains data indicative of input from a rumble strip into the tire if the difference is greater than a predetermined difference, the predetermined difference being greater for asphalt roads than for concrete roads.

37. The device according to claim 36, wherein the device includes a band-pass filter adapted to filter out vibrational frequencies.

38. The device according to claim 37, wherein the band-pass filter is a variable band-pass filter adapted to filter out different frequencies based on vehicle velocity.

39. The device according to claim 36, wherein the processor is adapted to receive information relating to longitudinal velocity of the vehicle and output a signal indicative of peak vibrational output from the road surface into the tire based on the longitudinal vehicle velocity.

40. A device adapted to determine whether a vehicle is deviating from a road, comprising:

a processor adapted to receive a series of signals indicative of contact of a

rumble strip with a tire of the vehicle, wherein the processor is further adapted to determine the length of time between receipt of the signals, and wherein the processor includes logic to:

determine that the vehicle is deviating from the road if the length of time between receipt of the signals is less than a first predetermined time period.

41. The device according to claim 40, wherein the processor is further adapted to determine the length of time that the signals are received, and wherein the processor further includes logic to:

determine that the vehicle is contacting a rumble strip if the length of time that a first signal of the series of signals is received is longer than a second predetermined time period; and

determine that the vehicle is deviating from the road if the length of time between the end of receipt of the first signal and a beginning of receipt of a second signal of the series of signals is less than the first predetermined time period.

42. The device according to claim 41, wherein the processor further includes logic to:

determine that the vehicle is deviating from the road if the length of time between the end of receipt of the first signal and a beginning of receipt of the second signal of the series of signals following the first signal is less than the first predetermined time period and the length of time that the second signal is received is longer than the second predetermined time period.

43. The device according to claim 42, wherein the processor is adapted to receive an intervening signal between the first signal and the second signal of the series of signals, and wherein the length of time that the intervening signal is received is shorter than the second predetermined time period.

44. The device according to claim 40, wherein the processor further includes logic to determine whether the vehicle is continuing to deviate from the road or whether the

vehicle is returning to the road.

45. The device according to claim 44, wherein the processor further includes logic to:

initiate a warning to a driver of the vehicle once the processor has determined that the vehicle is continuing to deviate from the road.

46. The device according to claim 44, wherein the processor is further adapted to issue a vehicle control command once the processor has determined that the vehicle is continuing to deviate from the road, and wherein the device further includes:

a vehicle control unit in communication with the processor, wherein the vehicle control unit is adapted to receive the vehicle control command and at least one of automatically steer the vehicle back onto the road and automatically brake the vehicle once the processor has determined that the vehicle is continuing to deviate from the road.

47. The device according to claim 40, wherein the processor further includes logic to:

determine that the vehicle is contacting a rumble strip if the length of time that the a signal is received is longer than a second predetermined time period.

48. A device adapted to determine whether vehicle contact with a road departure warning installation installed on a road should be ignored, comprising:

a processor adapted to:

receive a signal indicative of contact of a rumble strip with a tire of the vehicle;

analyze the received signal and determine that the rumble strip has contacted the tire;

receive input relating to the location of the rumble strip with respect to a plurality of driving lanes; and

receive input that the vehicle is driving on an undivided road and to

determine that the vehicle is driving on the undivided road; wherein the processor includes logic to:

issue at least one of a warning command and a vehicle control command when the rumble strip is located within driving lanes and the vehicle is driving on an undivided road.

49. The device according to claim 48, wherein the processor receives information based on GPS data to determine that the vehicle is driving on an undivided road.

50. The device according to claim 48, wherein the processor receives information based on a RADAR return to determine that the vehicle is driving on an undivided road.

51. The device according to claim 48, wherein the processor receives information based on a visual sensor return to determine that the vehicle is driving on an undivided road.